

Natural Gas Composition in California

What is in the gas that is leaking from California stoves?





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Dr. Lebel is senior scientist at PSE Healthy Energy. As a graduate student at Stanford University, he measured methane emissions from natural gas water heaters and stoves.



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Dr. Bilsback is senior scientist at PSE Healthy Energy. Her work uses modeling to evaluate the impacts of energy production and use on air quality and human health.

*Gas stoves create air pollution
when they are used*

Gas stoves leak even while they are off

*What else is this
besides methane?*



Findings

Finding #1: Natural gas used in California homes contains harmful compounds.

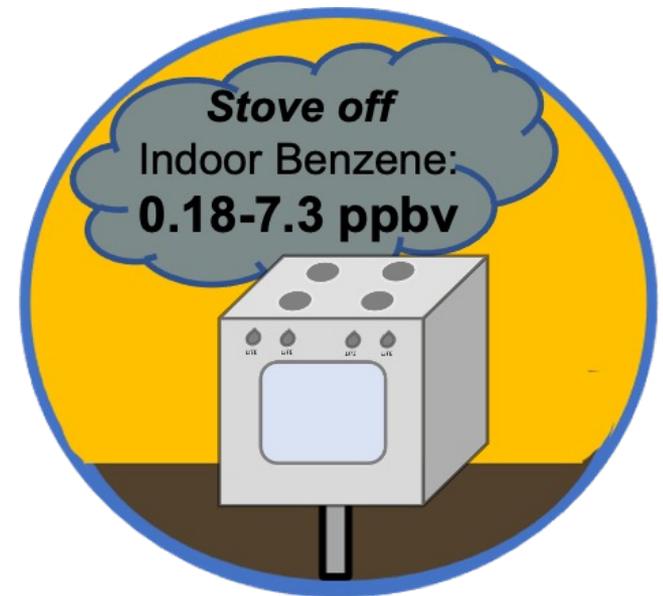
All 159 homes in California contained hazardous air pollutants, most notably benzene, toluene, xylenes, and hexane.

- We detected **12 different hazardous air pollutants** in total.
- We detected benzene – a known human carcinogen - in 99% of samples.

Finding #2: Natural gas leaks degrade indoor air quality.

Just having a gas stove in your kitchen can create benzene concentrations comparable to secondhand smoke.

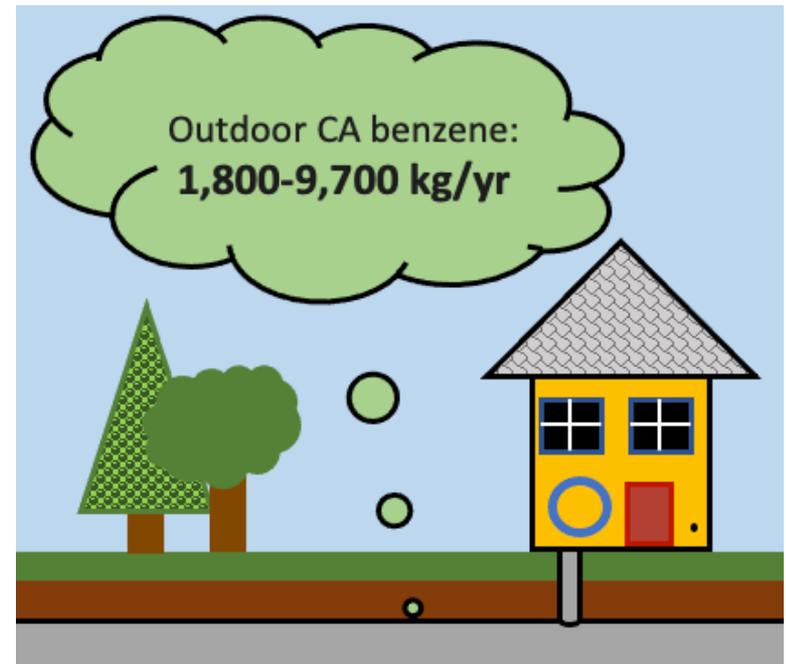
- In California, leaky stoves can exceed California's health exposure guidelines indoors up to **7x**



Finding #3: Natural gas leaks degrade outdoor air quality.

Leaks from gas appliances and the pipes that feed them emit the same amount of benzene each year as nearly 60,000 cars.

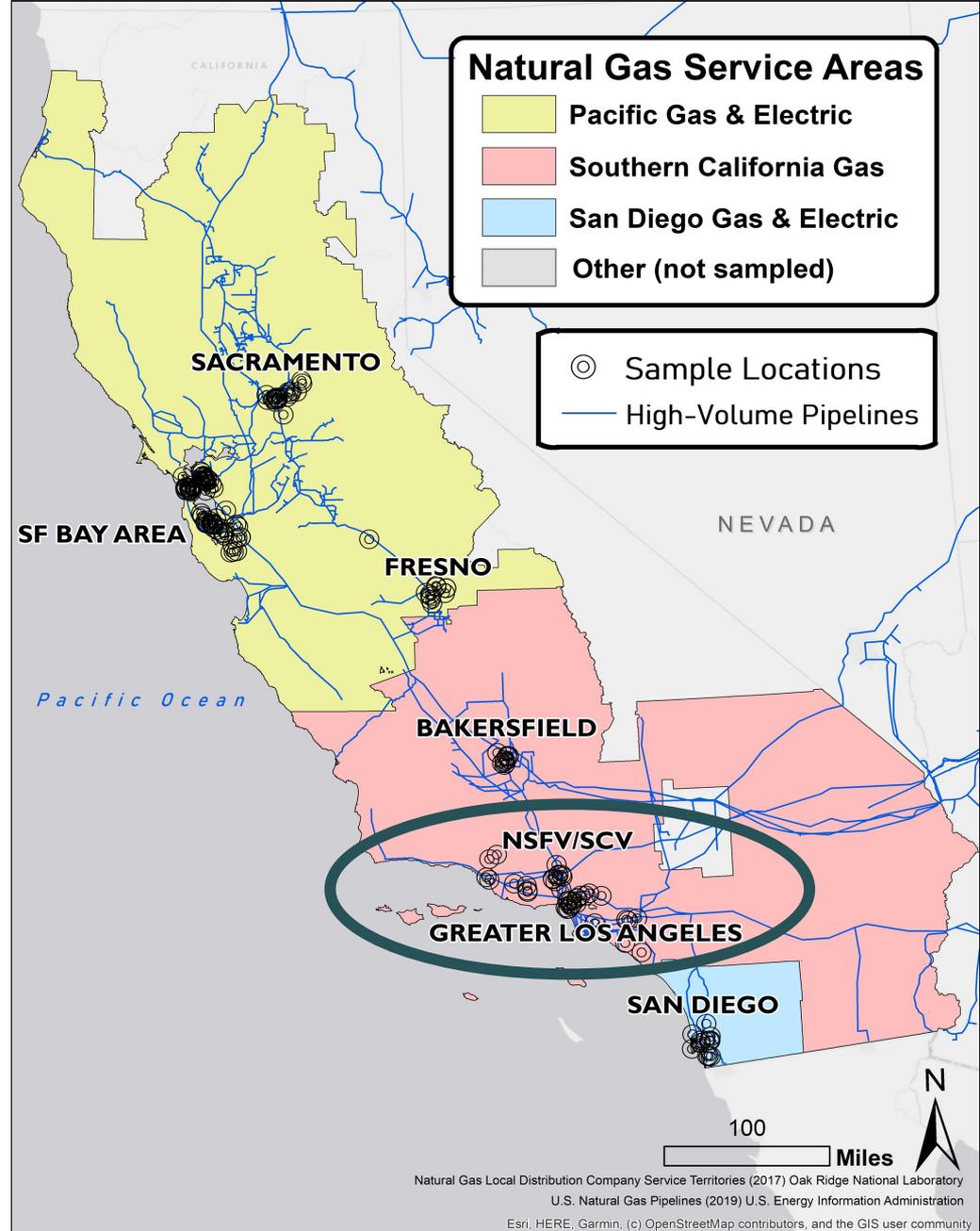
- Many inventories do not consider VOCs emitted in household and pipeline gas leaks, which means these are unaccounted-for sources of outdoor air pollution.
- We found that gas contains numerous smog-forming gases like ethane, hexane, toluene, ethylbenzene, xylenes, cyclohexane, etc.



Findings in Detail

We measured HAPs in natural gas across the state

- 3 different gas companies
- 7 different regions
- 159 total households
- 76 unique chemicals sampled



Ventilation

Stove
Leak

MODEL

Benzene
Concentration

Benzene
in Gas

Kitchen Size



Natural Gas Leaks and Health

- ***Health risk requires exposure to a hazard***
 - Compared the results to California Reference Exposure Level (REL)
 - California REL is the level at which no adverse health effects are anticipated
 - Exceeding the REL does not automatically indicate an adverse health effect
 - RELs are designed to protect the most sensitive populations

- ***Implications for Health***
 - First time showing that indoor leaks alone can exceed health-based guidelines
 - Outdoor gas leaks can form other harmful pollutants like ozone and PM

Conclusions & Implications

What does our study mean for health, climate, and policy?

Gas leaks are an unavoidable part of the system

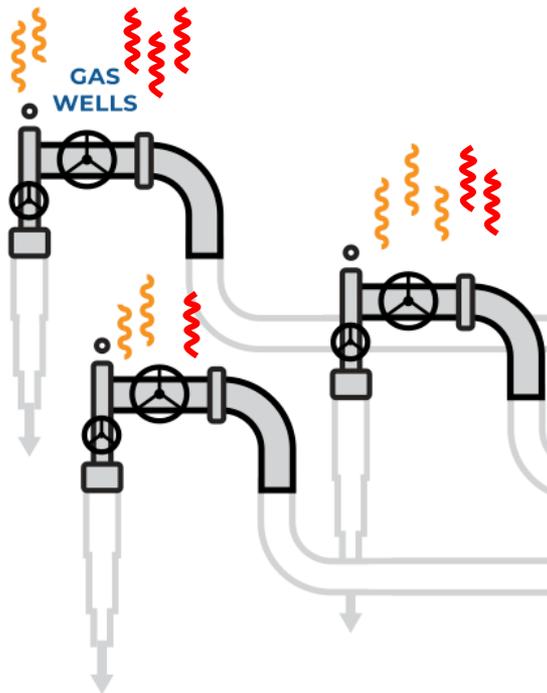


Methane

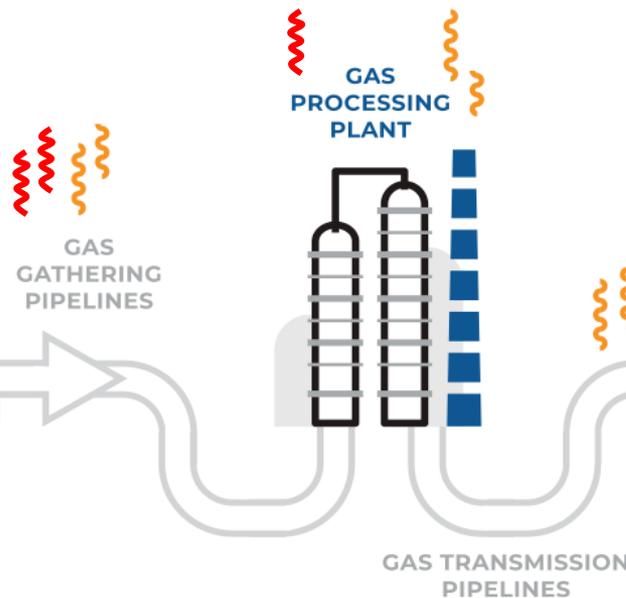


Hazardous Air Pollutants

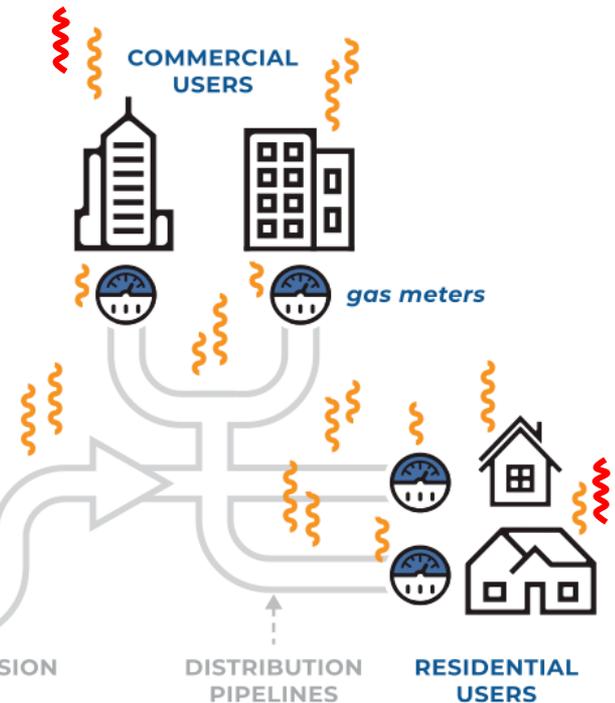
Production



Processing



Delivery



- Our work builds on the body of evidence that suggests that hazardous air pollutants are co-emitted with methane throughout the gas supply chain.

Conclusions & Implications

1. Gas leaks are unaccounted-for source of air pollution.

- Anywhere natural gas is leaked hazardous air pollutants are leaked.
- If fossil methane leaks are reduced, hazardous air pollutants will be reduced as well.

2. Gas leaks impact both indoor and outdoor air quality.

- Individuals, policies, or programs that replace gas appliances with cleaner options can improve indoor air quality.
- Future air quality policies should consider smog-forming compounds from appliance-, city-, and state-level natural gas leaks.

3. Gas appliances and systems impact public health and climate.

- Our study shows that policies that phase out gas appliances to protect climate likely have public health co-benefits.
- Reducing fossil gas system leaks or moving away from gas at a system level can protect our climate and public health.

Thank you!

Title of Study: Composition, Emissions, and Air Quality Impacts of Hazardous Air Pollutants in Unburned Natural Gas from Residential Stoves in California

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